ANGLER HARVEST SURVEY

TAGISH BRIDGE 2007

Prepared by:

Nathan Millar, Oliver Barker and Lars Jessup

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Copies available from:

Yukon Department of Environment
Fish and Wildlife Branch, V-5A
Box 2703, Whitehorse, Yukon Y1A 2C6
Phone (867) 667-5721, Fax (867) 393-6263
E-mail: environmentyukon@gov.yk.ca

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Key Findings

- Anglers spent 2,420 hours angling at Tagish Bridge in the summer of 2007. This effort was similar to that seen in the past 10 years, but lower than in the early 1990s.

- Angler success, as measured by the number of lake trout caught per hour of angling, was below average compared to other Yukon fisheries surveyed to date, but was similar to past surveys at Tagish Bridge.

- Anglers caught 191 lake trout, and released none, as Tagish Bridge is not a good place to release fish. The total estimated harvest was 567 kg of lake trout.

- It is not possible to assess the sustainability of the Tagish Bridge fishery without an understanding of the migration patterns of its lake trout in the Southern Lakes system. Studies are needed to address this information gap.

- Almost all anglers fished for lake trout. Anglers occasionally caught Arctic grayling and lake whitefish.

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Introduction

We conduct angler harvest surveys, also called creel surveys, on a number of Yukon recreational fisheries each year. We use these surveys, together with other fish and fishery-related assessments, to find out if the harvest of fish from the lake is sustainable. Environment Yukon's goal is to conduct angler harvest surveys on key fisheries either every 5 years or according to angler patterns and management concerns. The results of the surveys directly contribute to management decisions that make sure fisheries are sustainable over the long term.

The Tagish Bridge spans the short Tagish (or Six-Mile) River. Located in south central Yukon within the traditional territory of the Carcross/Tagish First Nation, the Tagish River is adjacent to the village of Tagish. Water flows from Tagish Lake through the Tagish River into Marsh Lake on its way to the Yukon River and eventually the Bering Sea.

The Tagish Bridge is a popular fishing destination due to ease of access, proximity to Whitehorse and nearby communities, and the chance to catch a large lake trout without needing a boat. Most anglers target lake trout that are moving between Marsh and Tagish lakes.

The high level of use and popularity of the Tagish Bridge fishery makes monitoring a priority. Angler harvest surveys have occurred on 7 previous occasions: 1990, 1992, 1993, 1994, 1995, 1998 and 2002.

The 2007 survey was done to:

- determine how much time anglers spent fishing (effort);
- understand the characteristics of the fishery and patterns of use;
- measure success rate of anglers;
- record biological information on harvested fish;
- provide anglers with information about regulations; and
- have an ongoing fisheries management presence.

Harvest Regulations

Tagish Bridge has been managed as a Special Management Water since 1995/96. Barbless hooks are required. The catch and possession limits for lake trout are one fish per day. Slot limits do not apply as the bridge is not a good place for live release fishing. Anglers are instructed to keep the first lake trout they catch and then stop fishing. The Arctic grayling catch limit is 4 fish per day with 4 fish in possession. All grayling between 40 cm and 48 cm must be released, and only one grayling in possession may be larger than 48 cm. The northern pike catch limit is 4 fish per day with 4 fish in possession. All pike

between 75 cm and 105 cm must be released, and only one pike in possession may be larger than 105 cm. General catch and possession limits apply to all other species.

The regulation history for Tagish Bridge is detailed in Appendix 1.

Methods

Survey

In 1990 the Yukon Government adopted survey methodology developed by the Ontario Ministry of Natural Resources (Lester and Trippel 1985). A field worker conducts face-to-face interviews with anglers on selected sample days throughout the summer. The worker asks a standard set of questions about the social and biological aspects of the fishery. Data gathered include:

- How much time did anglers spend fishing?
- What fishing methods did anglers use?
- How did anglers fish (boat, shore, etc.)?
- Were anglers guided?
- Where were anglers from?
- What type of visitor were anglers (day users, campers, etc.)?
- What kinds of fish were anglers trying to catch?
- How many fish did anglers catch?
- How many fish did anglers release?

Any other information offered by anglers about their fishing experience is also recorded.

The field worker also collects biological data on the catch of cooperative anglers. Biological data gathered include: length (mm), mass (g), sex, maturity, an aging structure, as well as the collection of stomachs for content analysis in the lab. Any other information about general health and condition of the fish is recorded by the field worker (e.g., abnormalities, disease, lesions).

The field worker subjectively assesses the weather's effect on fishing over the entire sample day (no possible adverse effect, possible adverse effect, definite adverse effect).

The timing of the survey depends on management objectives, key species, and the nature of the fishery. It typically runs from ice out in the spring until either just after Labour Day or the end of September. The goal is to sample at

least 20% of the total survey days. The survey is subdivided into several seasonal periods (usually 3 or 4) to better understand changes in angler activity. These periods are further divided into weekends and weekdays. Sample days are allocated to each period while considering both a higher weighting for those periods with the higher projected angler use and a minimum number of samples for each period.

Sample days are 14 hours long, 8:00AM to 10:00PM. On sample days, the field worker interviews all willing anglers. The field worker also records anglers who are observed but not interviewed.

Analysis

When the survey is finished, we enter the data into an Access database and analyze it using standard statistical methods. We determine the age of sampled fish by counting growth rings on the otolith (a small "bone" from the fish's head). Diet is determined by examining the stomach contents.

Fishery Productivity

The productivity of a waterbody determines the amount of fish produced annually and can guide how much harvest can be sustained. Estimates of lake productivity are calculated using average lake depth, the concentration of total dissolved solids, and the average annual air temperature at the lake. Ryder's morphoedaphic index (1974) is used and incorporated into Schlesinger and Regier's equation (1982) for calculation of maximum sustained yield (MSY) for all species. Calculation of MSY for lake trout assumes a biomass of 30% lake trout; where appropriate this may be replaced by the most recent survey data. Following O'Connor (1982) and others, 15% of MSY provides an "optimum" sustained yield (OSY), which maintains high quality fisheries on light to moderately fished lakes.

As a river, lake-based productivity calculation methods cannot be applied to Tagish River. Estimates of system-wide productivity, incorporating information from Bennett, Nares, Tagish and Marsh lakes, however, can provide insight into sustainability of system-wide harvest, including harvest at Tagish Bridge.

2007 Tagish Bridge Survey

The survey began May 20 and concluded September 5, 2007.

We used an access survey, meaning the field worker was stationed for the entire sample day at the bridge and boat launch at the north end of Tagish River (Figure 1) and interviewed angling parties at the end of their fishing trip.

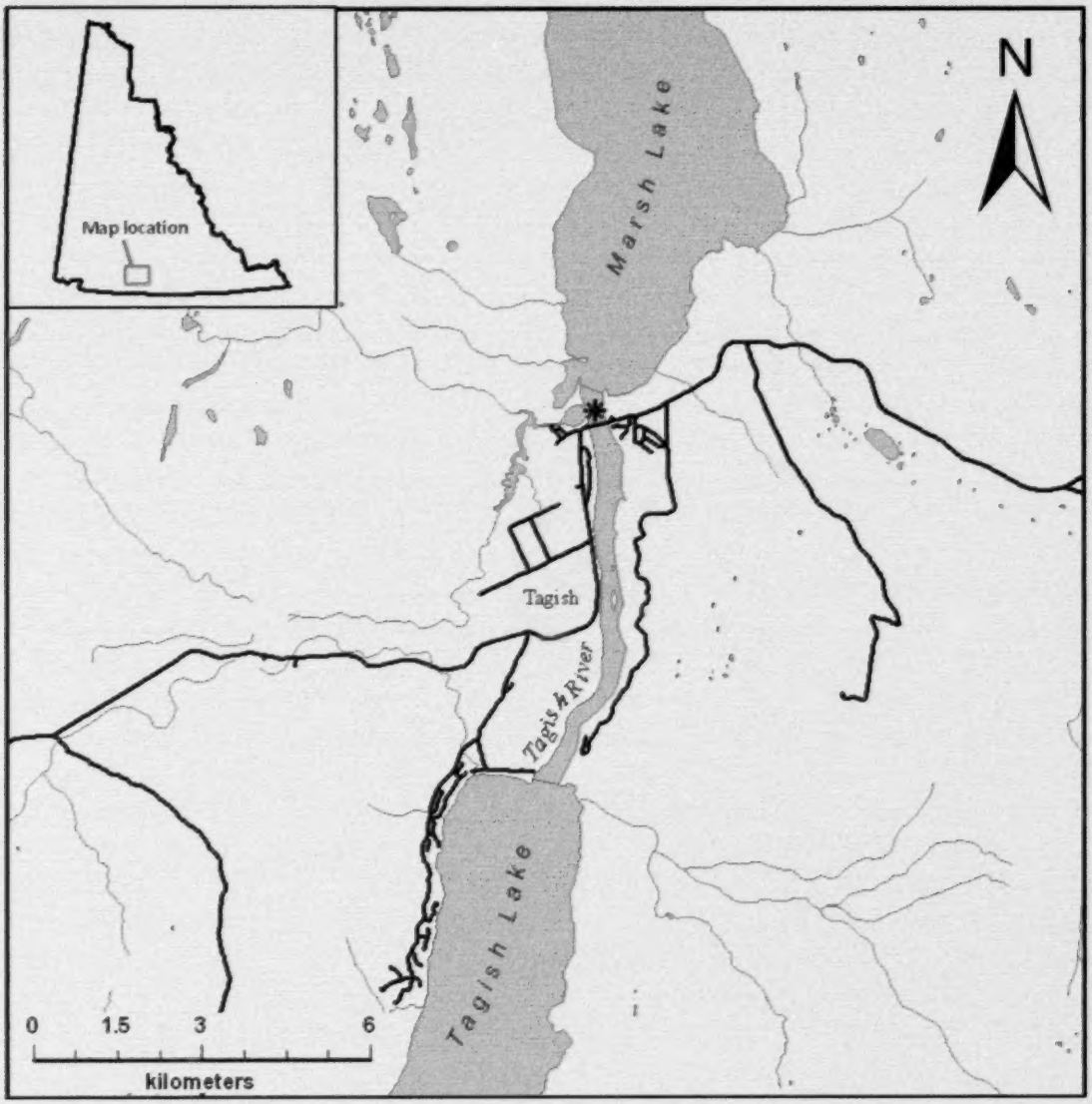

Figure 1. Tagish River, showing location of 2007 angler harvest survey at Tagish Bridge (*).

The survey period was partitioned into 6 time periods, weekends and weekdays in May/June, July and August/September. Of the 109-day survey period, 38 days were sampled, resulting in a sampling effort of 35%.

We analyzed the data 2 ways. In the first, we combined data across all 6 time periods, and in the second part we compared results between time periods (see Appendix 2).

Results of the 2007 Survey

Effort

Anglers spent 2,420 hours fishing at Tagish Bridge over the 2007 survey period. There were a total of 1,194 anglers in 760 parties. On average, there was 22.1 hours of angler effort per day over the entire survey, and each angler fished for 2.0 hours.

Fishing Methods

Still fishing was by far the most popular method of fishing (Table 1).

Table 1. Fishing methods.

Method of Fishing	Angling Parties (%)
Still	97
Jig	
Drift	
Troll	<1
Spin Cast	2
Fly Cast	
Other or Combination	<1

Methods of Access

The majority of anglers accessed the fishery from the bridge (Table 2). A few anglers accessed the river from shore and motorboat.

Table 2. Angler access methods.

Access Method	Angling Parties (%)
Canoe	
Rowboat	
Motorboat	1
Shore	1
Other	98

Guided Anglers

Guided anglers made up 1% of parties.

Angler Origin

Local and Whitehorse anglers were the most frequent fishers(Table 3). Other anglers included Canadians, Americans, and people from other regions of the world, usually Europeans.

Table 3. Angler origin.

Origin	Anglers(%)
Local	37
Whitehorse	37
Yukon	
Canada	16
U.S.	5
Other	4

Visitor Type

The majority of anglers were day users (Table 4). The only other group of users included Territorial campground users.

Table 4. Angler visitor type.

User Type	Angling Parties (%)
Day Users	82
Camper – Territorial Campground	18
Camper – Crown Land	
Camper – Private Campground	

Weather

Weather did not have an adverse effect on fishing activity (Table 5).

Table 5. Sample day weather.

Did Weather Affect Angling?	Angling Parties (%)
No Possible Adverse Effect	90
Possible Adverse Effect	9
Definite Adverse Effect	1

Catch and Harvest

Lake trout were the most frequently caught and harvested species (Table 6). All other species were caught incidental to the lake trout fishery. Anglers kept all fish caught at the Tagish Bridge (100% retention rate), as the bridge is not a good place to practice catch and release fishing.

Table 6. Angler catch and harvest.

	# Caught	# Kept	Retention Rate (%)
Lake trout	191	191	100
Lake whitefish	2	2	100
Arctic grayling	3	3	100

Estimated angler success rates, calculated over the entire survey as numbers of fish caught per hour of angling effort (CPUE), is presented for all anglers (regardless of target species) in Table 7.

Table 7. Estimated catch per unit of effort (fish/hour).

	CPUE
Lake trout	0.079
Lake whitefish	0.0008
Arctic grayling	0.001

Biological Data

We sampled 56 lake trout for fork length (mean 610 mm) and weight (mean 2,967 g). These fish had a mean condition factor of 1.31, which is above average for lake trout in Yukon, and indicates "fat" fish (condition factor is the

relationship between length and weight). The sex ratio was 1.6 females per male. Similar numbers of lake trout were harvested across a wide range of size classes from 400 to 850 mm (Figure 2).

We aged 52 of the sampled lake trout. These fish ranged from 6 to 31 years old with a mean age of 14.2 years (Figure 3). Note that young fish (less than 5 years old) are not vulnerable to angling gear. This portion of the population is therefore under represented in the sample.

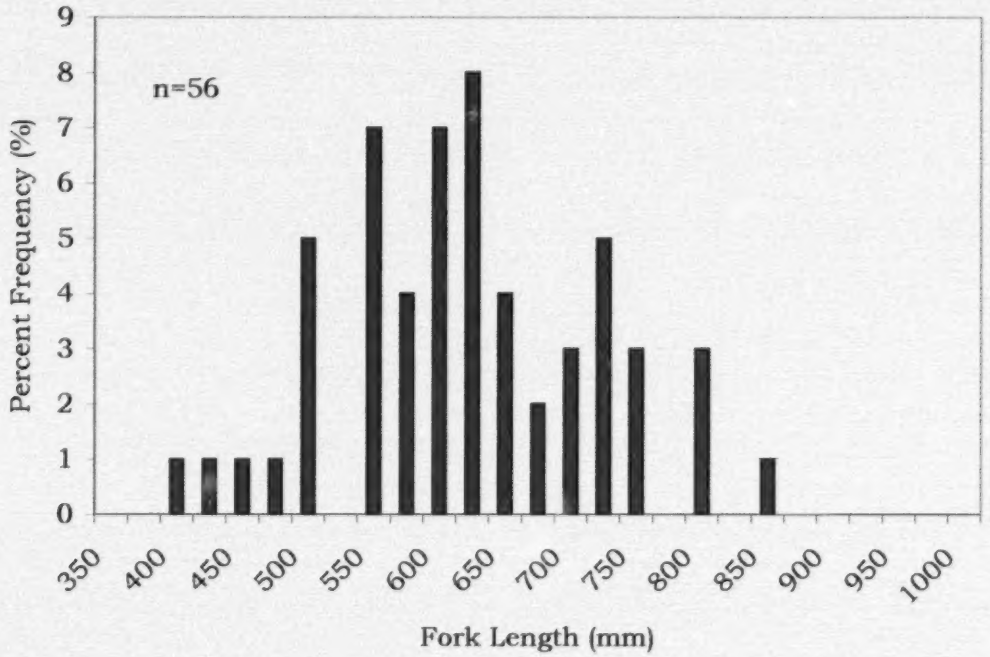

Figure 2. Lengths of lake trout caught by anglers.

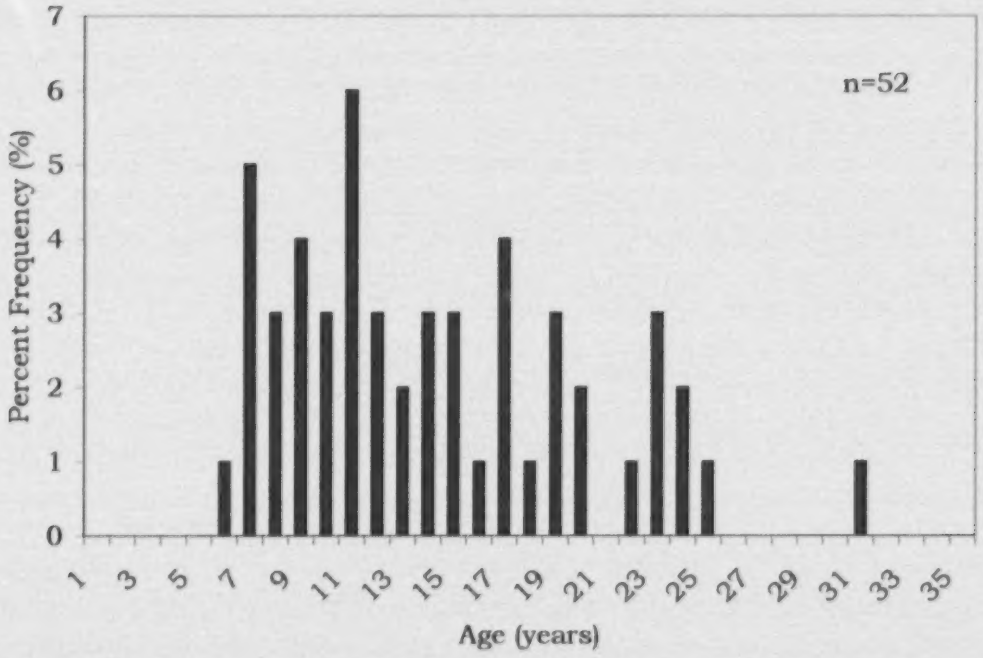

Figure 3. Ages of lake trout caught by anglers.

We examined the stomachs of 56 lake trout. Of these, 6 were empty, and the remaining 50 averaged 80% full. Unidentified fish were the most common diet item found (Table 8). No other species were sampled for biological data over the survey.

Table 8. Stomach contents of sampled lake trout.

	Volume (%)
Unidentified Fish	84
Caddisflies	11
Pond Snails	1
Unknown	1
Non-Biting midges	1
Orb snails	<1
Slimy sculpin	<1
Snails	<1
Unidentified amphibians	<1
Unidentified vegetation	<1
Scuds, Sideswimmers	<1

Comparison with previous surveys

We previously surveyed the angler harvest at Tagish Bridge 7 times since 1990. These surveys were of similar methodology and design and are directly comparable with the 2007 survey.

Effort

Estimated summer open water angler effort over the past 17 years has fluctuated greatly with an overall declining trend (Table 9). We estimate 2,420 angler hours of effort over the 2007 survey. This estimate is similar previous 2 surveys but has dropped significantly since the early 1990s.

Table 9. Total estimated angler hours.

	2007	2002	1998	1995	1994	1993	1992	1990
Hours	2,420	2,296	2,817	3,693	3,105	4,317	6,922	4,004

Fishing Methods

Although we noted a shift in reported fishing methods over the surveys we attribute the changes in fishing methods to differences in how surveyors recorded the data. Fishing from the bridge recorded was as "Other" in 1994, "Spin Cast" in 1995 and 1998, and "Still" in 2002 and 2007 (Table 10). Data are not available from 1990, 1992, and 1993.

Table 10. Fishing methods of angling parties (%).

	2007	2002	1998	1995	1994	1993	1992	1990
Still	97	98			8			
Jig		1		2	6			
Drift								
Troll	<1					N/A	N/A	N/A
Spin Cast	2	1	100	94	4			
Fly Cast								
Other or Combination	<1			4	81			

Methods of Access

Methods of access were only recorded in 2007 and 2002 (Table 11). It is presumed that all previous surveys had similar percentages of bridge (other) anglers.

Table 11. Methods of access of angling parties (%).

	2007	2002	1998	1995	1994	1993	1992	1990
Canoe								
Rowboat								
Motorboat	1				Data Not Available (1990–1998)			
Shore	1	1						
Other	98	99						

Guided Anglers

Formally guided parties have accounted for 0 - 4% of the angler effort in all surveys (Table 12).

Table 12. Guided angling parties (%).

	2007	2002	1998	1995	1994	1993	1992	1990
Yes	1				4	N/A	N/A	N/A
No	99	100	100	100	96			

Angler Origin

Over the 17 years of survey data, the proportion of local anglers has increased. There has been a corresponding drop in other categories, in particular American anglers (Table 13). Whitehorse anglers were dominant in all years prior to 2007

Table 13. Origin of angler parties (%).

	2007	2002	1998	1995	1994	1993	1992	1990
Local	37	32	23	20	19	23	9	N/A
Whitehorse	37	49	52	43	42	44	55	N/A
Yukon		4		6	5	8		59
Canadian	16	8	17	14	17	14	23	20
U.S.	5	6	7	8	15	9	13	20
Other	4	1	2	8	3	3	1	1

Visitor Type

Visitor type at Tagish Bridge has shown similar results in previous surveys (Table 14). Day users were dominant while campground users made up the minority. These data were not recorded before 2002.

Table 14. Visitor type of angling parties (%).

	2007	2002	1998	1995	1994	1993	1992	1990
Day Users	82	91						
Camper – Territorial Campground	18	9						
Camper – Crown Land					Data Not Available (1990-1998)			
Camper – Private Campground								

Weather

The field worker's subjective assessment of weather effects on angling activity indicates that weather was poorest in 2002 (Table 15). Weather data were not collected in 1990 or 1994.

Table 15. Weather effects on activity of angling parties (%).

	2007	2002	1998	1995	1994	1993	1992	1990
No Possible Adverse Effect	90	28	83	83		66	97	
Possible Adverse Effect	9	69	14	14	N/A	27	3	N/A
Definite Adverse Effect	1	3	3	3		7	0	

Catch and Harvest

Lake trout catch estimates for 2007 were lower than the previous surveys, except 1998 (Table 16). Due to the nature of the bridge fishery, harvest rates of 100% have remained consistent over the past 3 surveys and have always been high.

Lake whitefish catch has only been reported in 4 of the 8 surveys. More recent estimates show that catches are incidental, with lake whitefish being retained in 2007, 1998, 1995, and 1993. Least cisco catches, once the most heavily harvested fish, have declined and have not been reported caught

through the survey since 1995. Northern pike catches have not been reported since 1998. The retention rate for these species is also high.

Table 16. Estimated number of fish caught, fish kept and the retention rate.

		2007	2002	1998	1995	1994	1993	1992	1990
Lake trout	Caught	191	223	81	300	286	442	995	410
	Kept	191	223	81	295	262	375	936	348
	Released	0	0	0	5	24	67	59	62
	% Kept	100	100	100	98	92	85	94	85
Northern pike	Caught			41	11	9	13		
	Kept			41	7	6	13		
	Released			0	4	3	0		
	% Kept			100	64	67	100		
Arctic grayling	Caught	3			4	11			
	Kept	3			4	11			
	Released	0			0	0			
	% Kept	100			100	100			
Least cisco	Caught				613	274	840		
	Kept				613	274	838		
	Released				0	0	2		
	% Kept				100	100	99.8		
Lake whitefish	Caught	2		2	19		18		
	Kept	2		2	14		18		
	Released	0		0	5		0		
	% Kept	100		100	74		100		

Estimated CPUE (number of fish caught per angler hour) over the entire survey can reflect the changes in the fishery because it incorporates effort and catch. Dramatic decreases in CPUE for a particular species could indicate problems in terms of the health or status of the fish species in question. However, relying on CPUE of anglers alone is not recommended – see the section entitled "Invisible Collapse" in the *Status of Yukon Fisheries 2010* (Environment Yukon 2010) – anglers are very good at finding fish even when the population is in decline.

Lake trout CPUE has demonstrated stability between 1990 and 2007 (Table 17). Results are slightly below the Yukon average for lakes and rivers surveyed to date.

Table 17. Estimated catch per unit of effort (fish/hour).

	2007	2002	1998	1995	1994	1993	1992	1990
Lake trout	0.08	0.10	0.03	0.08	0.09	0.10	0.14	0.10
Northern pike			0.01	0.003	0.003	0.002		
Least cisco				0.17	0.09	0.20		
Lake whitefish	0.0008		0.00	0.005		0.004		
Arctic grayling	0.001			0.001	0.004			

The CPUE data for species other that lake trout should be treated with caution. These species receive only a small amount of fishing effort, and so these estimates are quite rough.

Biological Data

Over the 8 surveys, we have sampled 645 lake trout for biological data. The average lake trout harvested from Tagish Bridge is 12 years old, 2.2 kg, and 57cm long (Figs. 4 – 7). Most lake trout harvested are 8 years or older and over 50 cm. The oldest fish harvested was 31 years.

Fish in this population have very quick growth when young and then very slow growth as they age. The length-at-age relationship is very flat or shallow (Figure 6) and there is considerable variation in size-at-age indicating that individual growth rates are highly variable. We also found a typically tight correlation between size and weight (Figure 7).

Changes in size or age of harvested fish over time can indicate changes in the population, but no worrying trends are apparent in the Tagish Bridge fishery. There are no trends in the age of harvested fish (Figure 8). The average length of lake trout harvested appears to have increased slightly in recent years (Figure 9). Lake caught in 1990 – 1998 averaged 556 mm while those caught in 2002 and 2007 averaged 637 mm, an 80 mm increase. This increase appears to be from an increase in the proportion of large fish caught in the last 2 surveys, rather than a decrease in the number of small fish caught (Figure 9). More large fish is not a concern and could indicate relaxed pressure elsewhere or the success of slot limits in protecting large fish on surrounding Conservation Waters.

Since there are very few fish released, the biological data from this fishery should be quite representative of the population they are harvested from (in other words, anglers keep all fish, even the small ones), with the exception of fish too small to be vulnerable to angling.

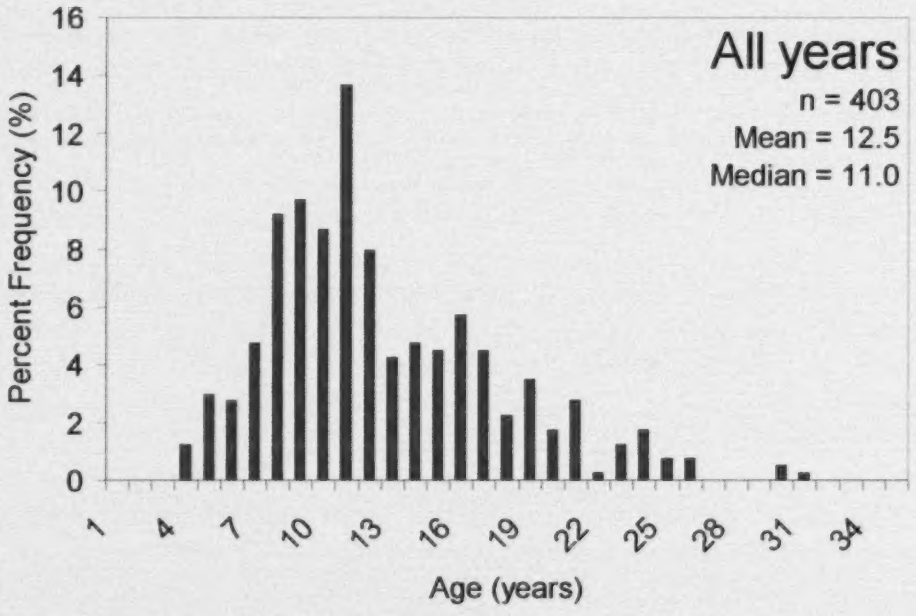

Figure 4. Ages of lake trout caught by anglers at Tagish Bridge from all survey years (1990 – 2007).

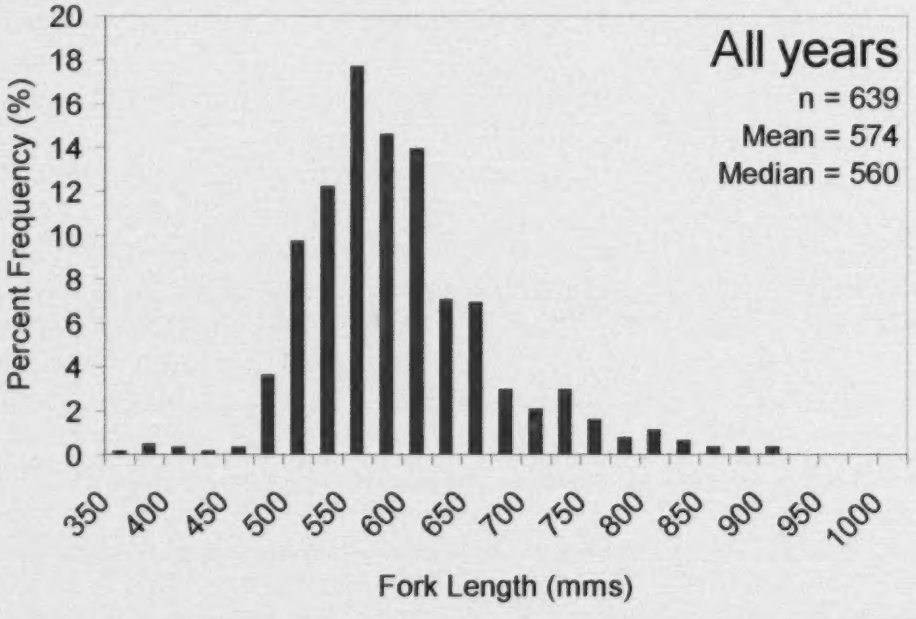

Figure 5. Lengths of lake trout caught by anglers at Tagish Bridge from all survey years (1990 – 2007).

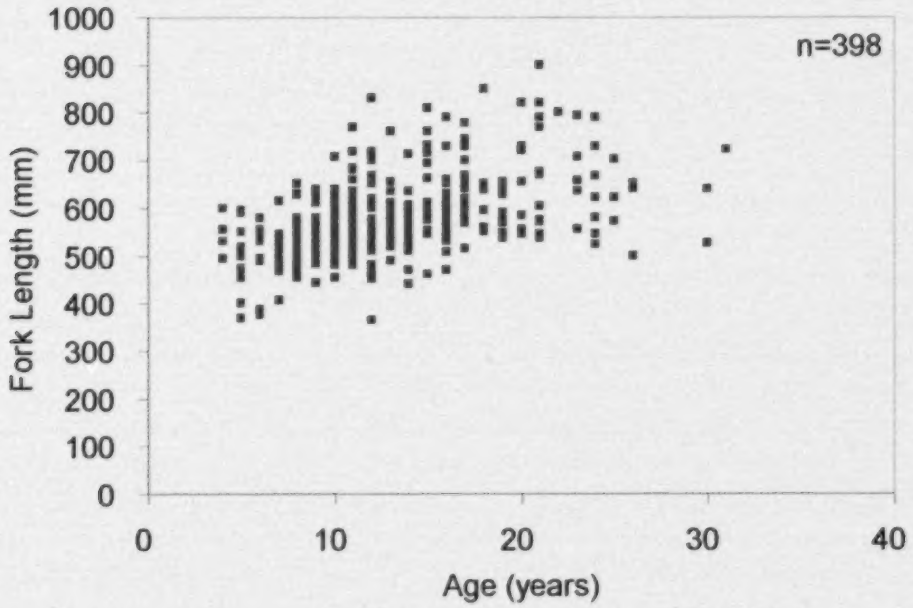

Figure 6. Length-at-age of lake trout caught by anglers at Tagish Bridge from all survey years (1990 – 2007).

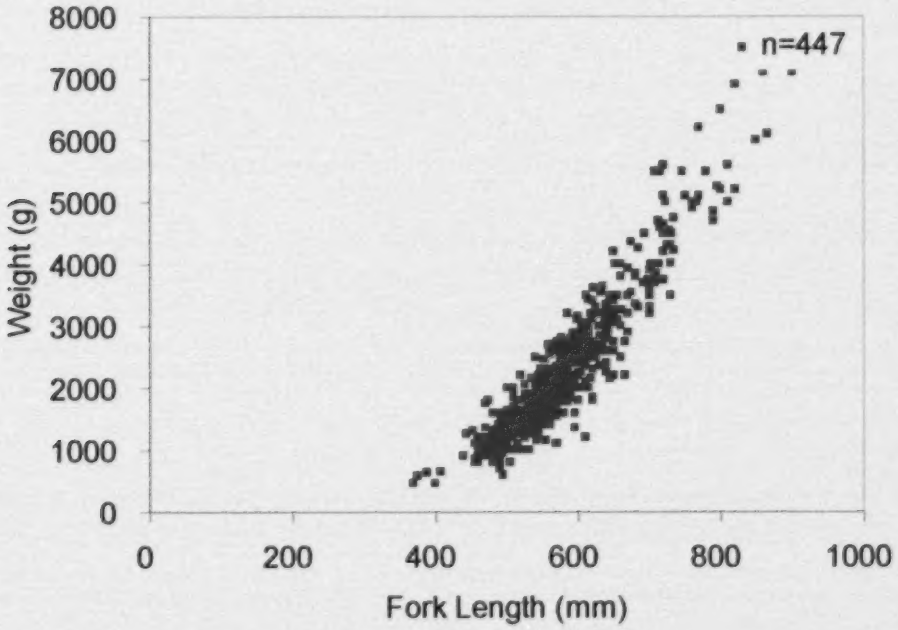

Figure 7. Weight-at-length of lake trout caught by anglers at Tagish Bridge from all survey years (1990 – 2007).

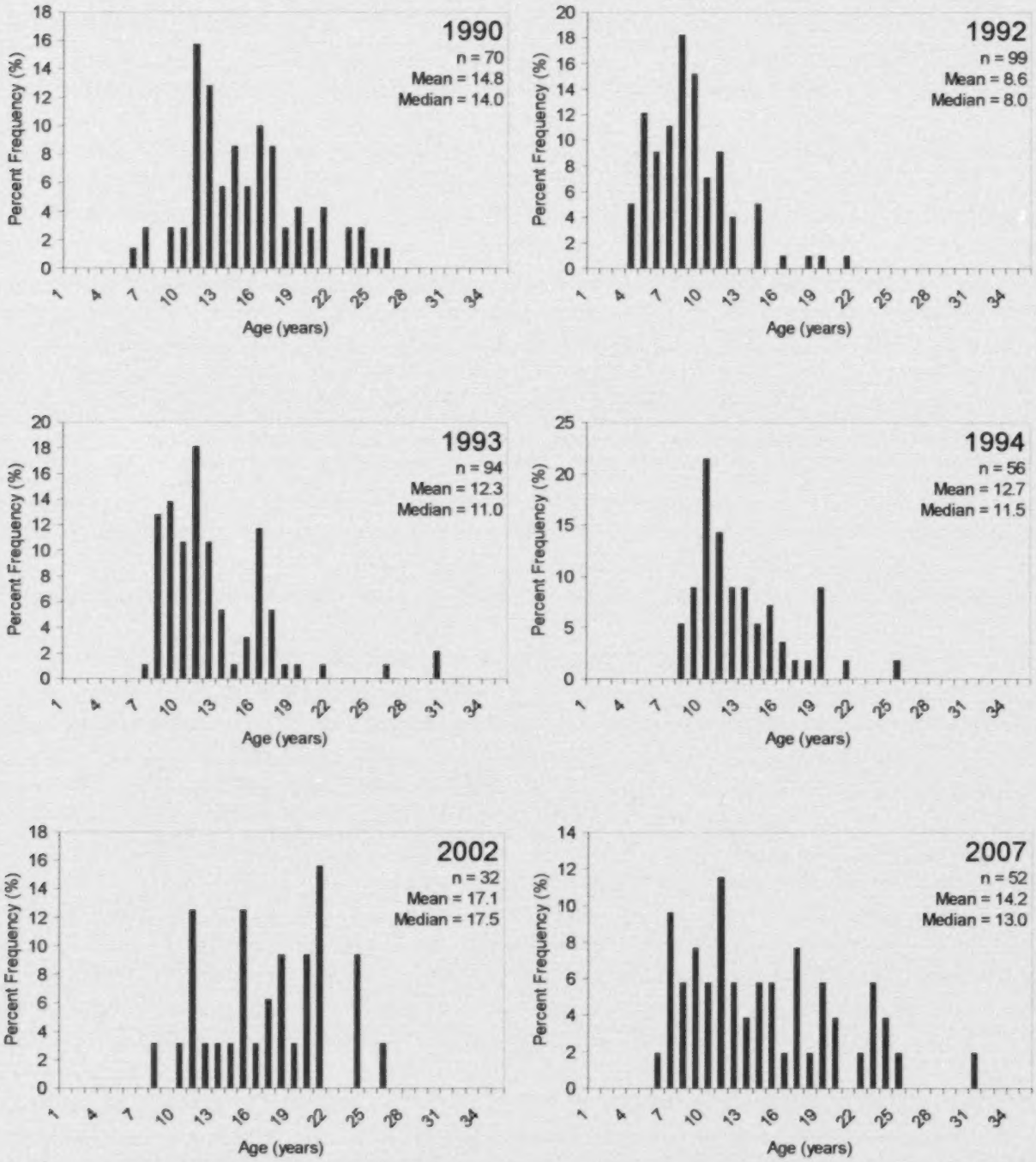

Figure 8. Ages of lake trout caught by anglers at Tagish Bridge for each survey year (1990 – 2007). Age data from 1995 and 1998 are not available.

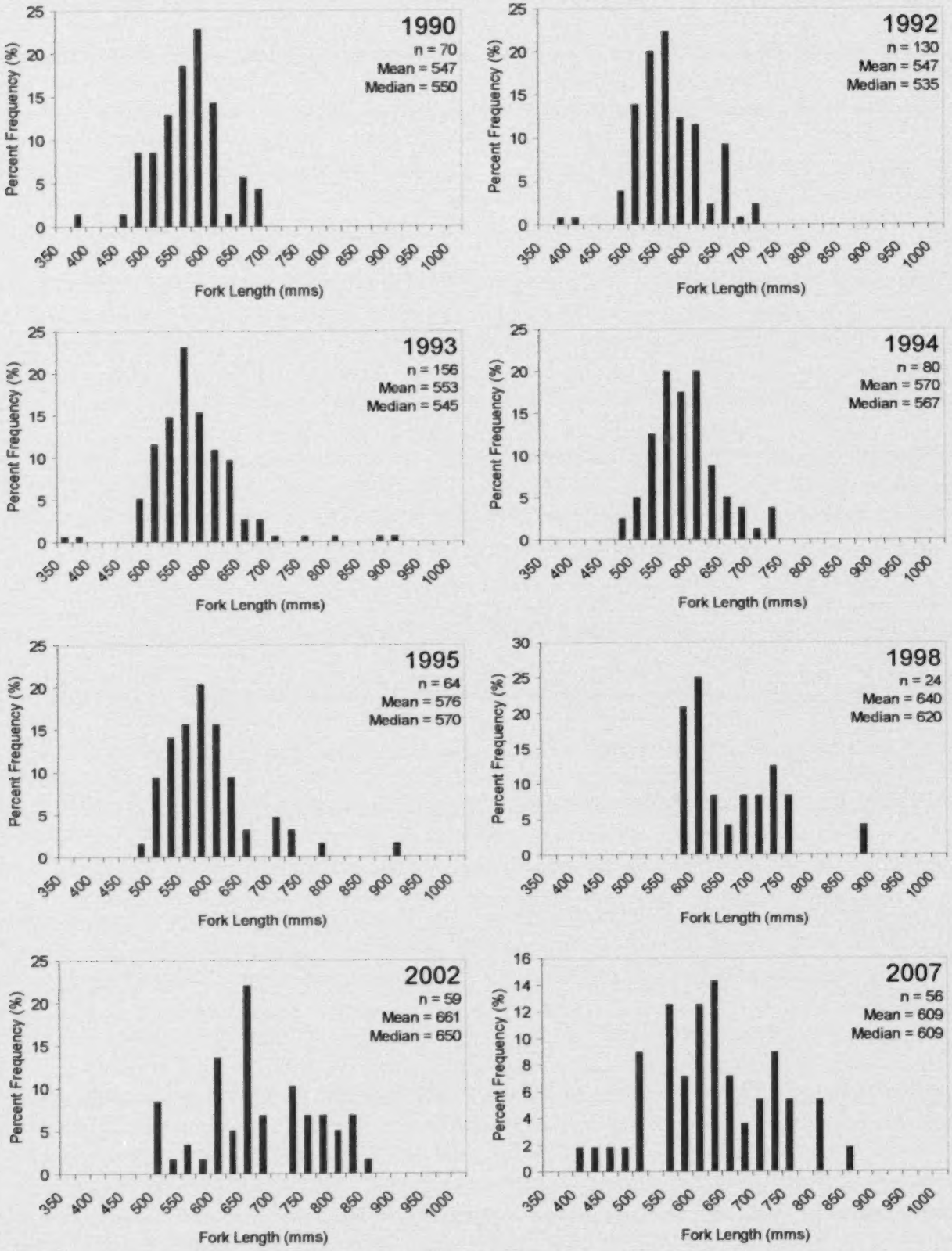

Figure 9. Fork length of lake trout caught by anglers at Tagish Bridge for each survey year (1990 – 2007).

Fishery Sustainability

Assessing the sustainability of the fishery at Tagish Bridge cannot be done with typical methods that use lake productivity to estimate sustainable yield. Lake trout caught at the Tagish Bridge are not resident there, but are caught when moving between Marsh and Tagish lakes. We do not know to which of these lakes these trout 'belong', or if the migratory fish are from both lakes. To fully understand the impact of this fishery, it will be necessary to determine the origin (i.e. where they spawn) and migration patterns of these fish (how much time they spend in the river, in the lakes, and in which lakes). Until then, assessing the harvest of lake trout against a sustainable yield is not possible.

Anglers harvested 191 lake trout over the summer (Table 18). Based on the average size of harvested fish, the weight of total lake trout mortality in the recreational fishery was 567 kg.

Our estimate of 567 kg harvest is a minimum. It does not include harvests from the open water fishery outside of the period of this survey, from the ice fishery, or from the First Nations subsistence fishery. The Carcross/Tagish First Nation uses Tagish River for subsistence fishing but no data on this harvest are available. The ice fishery on Tagish River has never been formally monitored, but anecdotal information suggests that effort and harvest are minimal.

Table 18. Estimated summer lake trout harvest by anglers.

	2007	2002	1998	1995	1994	1993	1992	1990
Number harvested	191	223	81	295	262	375	936	410
Mean wt. (kg)	2.97	3.36	3.38	2.26	2.05	1.87	1.76	1.73
Harvest Estimate (kg)	567	749	274	667	537	701	1,647	710

The Tagish Bridge fishery is similar to that at Nares River; both locations provide easy access to fish concentrated in a narrow waterway. The harvest of lake trout at Tagish Bridge is part of the harvest from either Marsh or Tagish lakes, or possibly Bennett Lake. Consequently, this harvest should be considered in the larger, system-wide lake trout harvest.

Productivity calculations predict that the Southern Lakes system could collectively sustain an annual lake trout harvest of 4,002 kg and maintain fishing quality (unpublished data; Table 19). We estimate current harvest at 3,043 kg (76%). These harvest numbers should be considered a minimum, however, as they do not include open water harvest from outside of the survey periods, harvests from ice fisheries, or First Nation subsistence harvest. Nor do

these productivity estimates consider that some lakes, such as Marsh Lake, may have experienced past overharvest (Millar et al. 2012). A lake trout population reduced by overharvest may not be able to sustain harvests even at the predicted OSY. Of additional consideration is that a harvest of 567 kg represents a significant proportion of OSY for either Marsh or Tagish Lake (56% for Marsh Lake and 23% Tagish Lake) and the Tagish Bridge harvest has historically been higher.

Table 19. Productivity and lake trout harvest estimates for the Southern Lakes system.

	OSY (kg)	Lake Trout Harvest (kg)		
		Summer Recreational	Commercial	Total
Bennett Lake	535	112	354	466
Nares River		195	n/a	195
Tagish Lake (includes Nares Lake)	2,457	1,505	n/a	1,505
Tagish Bridge		567	n/a	567
Marsh Lake	1,010	310	n/a	310
Total	**4,002**	**2,689**	**354**	**3,043**

The biological data support the hypothesis of healthy populations underlying this fishery. The age distribution of harvested fish has not changed much since the first survey. Length data suggest that there is a greater proportion of large fish in the population, a potentially promising sign of a sustainable fishery.

Nonetheless, without further knowledge about the origin, movement, and population size and structure of lake trout within the Southern Lakes, we cannot assign the Tagish Bridge lake trout harvest to lake-specific production. Studies to determine the migration of lake trout between the Southern Lakes are needed to make robust conclusions about the sustainability of the Tagish Bridge fishery. In the interim, it is important to continue monitoring the Tagish Bridge harvest.

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APPENDIX 1. Tagish Bridge angling regulation changes 1989 to 2007.

Year	Species	Catch limit	Possession limit	Size restrictions
1989/90*			General Regulations	
	Lake trout	3	6	Only one fish over 80 cm
	Arctic grayling	5	10	none
	Northern pike	5	10	none
	Whitefish	5	10	none
1991/92			General Regulations	
	Lake trout	3	6	Only one fish over 65 cm
	Arctic grayling	5	10	Only one fish over 40 cm
	Northern pike	5	10	Only one fish over 75 cm
	Whitefish	5	10	none
1995/96			Special Management Waters (Waters with Special Regulations)	
	Lake trout	1	1	none
	Arctic grayling	4	4	None between 40 and 48 cm; only one over 48 cm
	Northern pike	4	4	None between 75 and 105 cm; only one over 105 cm
			Anglers are encouraged to keep the first trout they catch.	

* Yukon Government obtained responsibility for freshwater fisheries management from the Federal Government in 1989.

APPENDIX 2. 2007 Results: Comparisons between periods

Effort

Mean daily angler effort on weekends was highest in July while May/June and August/September weekends were much quieter (Figure 2.1). Weekday effort was also highest in July and lower in May/June and August/September.

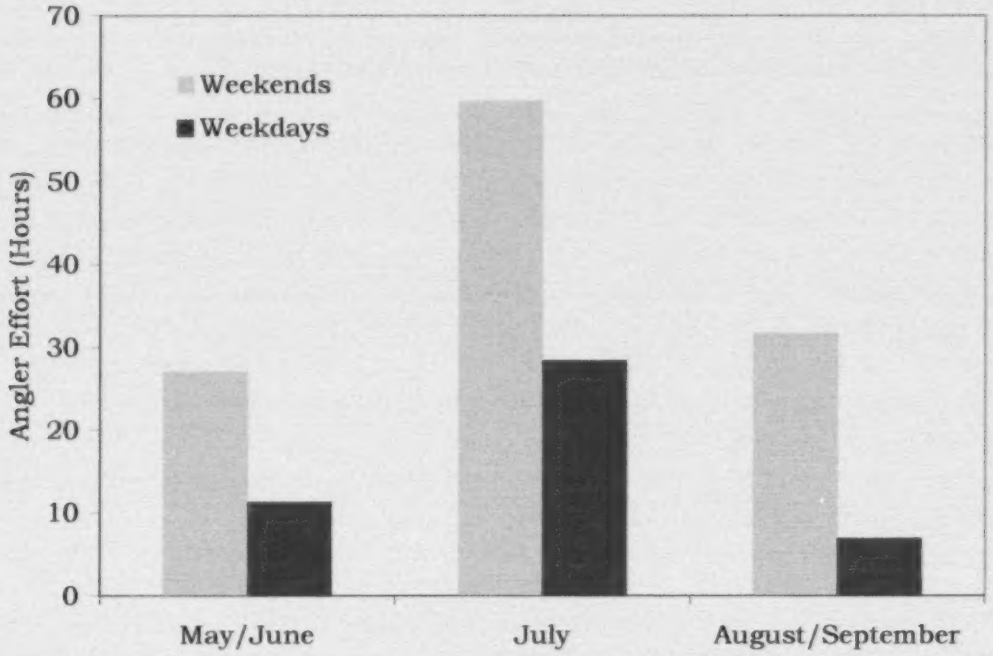

Figure 2.1. Estimated angler effort per day.

Fishing Methods

Due to the nature of the fishery, fishing methods were consistent across all periods in the survey, with most anglers still fishing.

Visitor Type

Day users were by far the dominant users in all periods. Government campground users were most abundant on weekends.

Catch

Lake trout CPUE was low over the summer but highest in May/June and July weekends (Table 2.1). CPUE for other species was very low, as these fish were incidental catches of the lake trout fishery.

Catch per unit effort patterns for lake trout were not consistent with typical Yukon summer patterns. Usually success is highest in the spring following ice out and then drops as water temperature rises. Fall increases are usually related to onset of spawning and cooling water temperatures. These fluctuations are not dramatic on Tagish Bridge as CPUE remained fairly low, but consistent over the summer.

Table 2.1. Estimated catch per unit of effort (fish/hour) by period.

	Lake Trout	Lake Whitefish	Arctic Grayling
May/June weekends	0.06	0.005	
May/June weekdays	0.12		0.012
July weekends	0.067		
July weekdays	0.11		
August/September weekends	0.035		
August/September weekdays	0.029	0.02	